Wetland Ways:
Interim Guidelines for Wetland Protection and Conservation in British Columbia



March 2009

Wetland Stewardship Partnership

These interim guidelines have been prepared with input from many experienced reviewers. They will be updated using experience from pilot testing and feedback from user groups. If you would like to comment on these guidelines, please send your comments to wsp@gov.bc.ca

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Wetland Stewardship Partnership Steering Committee: Andrea Barnett (Ducks Unlimited); Jan Kirkby (Environment Canada, Canadian Wildlife Service); and Ted Pobran (B.C. Ministry of Environment).

Authors: Robert K. Cox (R.K. Cox and Associates) with Judith Cullington (Judith Cullington & Associates).

Cover photos: Judith Cullington, Robert Cox.

Spadefoot toad—metamorph. PHOTO: SARMA LIEPENS

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All chapters are available on-line at the Ministry of Environment website http://www.env.gov.bc.ca/wld/BMP/bmpintro.html and the Ducks Unlimited website http://www.ducks.ca/province/bc/index.html.

Wetland Ways

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Interim Guidelines for
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Chapter One

INTRODUCTION

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Cover photos: Susan Latimer, Judith Cullington.

Wetland Stewardship Partnership

CHAPTER 1: INTRODUCTION

Wetlands are among the most biologically diverse life support systems on earth.
PHOTO: DOUG BIFFARD

1.1. WETLAND WAYS

This document is written primarily for people who are planning some form of activity or development near wetlands, as well as those looking for guidance on ways to best maintain the high ecological values in these areas.

A healthy natural environment is the foundation of British Columbia's (B.C.'s) economy and quality of life.

Wetlands are among the most biologically diverse, productive, and important life support systems on earth. They are integral to the functioning of many important ecosystems and life forms in B.C. They also provide people with a wide range of beneficial services, from flood control and water supply to recreational opportunities. Often, these services are unrecognized and undervalued, leading to the loss or impairment of wetlands—and thus the services they had provided are either costly or impossible to replace. See SECTION 1.1.4: WETLAND for more information.

The guidelines are not mandatory, but following these practices can bring many benefits to land managers as well as to the wetland ecosystems and the species they support.

We—governments, the private sector, and civil society—all have a part to play in wetland protection. The responsibility of protecting the environment is shared by federal and provincial governments, local governments, First Nations, private landowners and managers, non-governmental organizations and individual citizens. This document is one of a series of Guidelines and Best Management Practices documents that provides guidance on the protection and management of ecosystems in British Columbia.

LIVING WATER SMART

Protecting and rehabilitating wetlands is part of *Living Water Smart: British Columbia's Water Plan*. This work includes continuing B.C. government participation in the Wetland Stewardship Partnership and the development and implementation of the Wetland Action Plan, including support for the implementation of the *Green Bylaws Toolkit for Conserving Sensitive Ecosystems and Green Infrastructure* and developing wetland best management practices to provide guidance to landowners, land managers, local governments, developers, utility companies, businesses and industries, and agencies. As well, the Province is developing a wetland mitigation and compensation strategy that supports no net loss (and where appropriate, net gain) of wetlands where wetland losses from development have resulted in impaired watershed hydrology.

VALUABLE WETLANDS

Dr. Nancy Olewiler of Simon Fraser University estimates that the services provided by wetlands in the lower Fraser Valley are worth at least $230 million per year in foregone waste treatment costs alone, noting that their value is many times higher if the capital costs of the necessary infrastructure are added. The annual value of waste treatment of phosphorus and nitrogen produced by one hectare of the Fraser Valley's wetlands is estimated to be at least $452 and possibly as high as $1,270; while the annual nitrogen and phosphorus waste treatment benefits received from the existing 40,000 hectares of wetlands in Lower Fraser Valley wetlands could amount to between $18 and $50 million per year. (Olewiler, 2004)

1.1.1. Wetlands in British Columbia

A wetland is "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic (water-loving) vegetation, and various kinds of biological activity which are adapted to a wet environment." (National Wetlands Working Group, 1988)

Simply put, a wetland is "any area of land that is covered with water for a part of the day or a part of the year".[1] Wetlands form where water is at, above or near the surface for so much of the time that soils and vegetation adapt to the saturated conditions. The riparian area surrounding the wetland is an integral part of the wetland ecosystem.

You can find more information on wetlands and wildlife conservation at the Ducks Unlimited B.C. website http://www.ducks.ca/province/bc/index.html

Wetlands come in many varieties and with many different characteristics. The distinction between them is based on water levels, frequency of flooding, and the types of soil and plant life. Because wetlands are so variable, they can be hard to define. General characteristics are:

- **Water:** water is found at, above or near the surface of the wetland, for some or all of the day or year;
- **Vegetation:** plants are adapted to grow in water and soils that are saturated with water. The presence of these *hydrophytic*[2] plants is often an easy way to identify a wetland; and
- **Soil:** The soil is *hydric*, or waterlogged for some or all of the year.

Some wetlands are wet year-round. Others dry out for part of the time; for example some freshwater wetlands dry out completely during summer months, while saltwater wetlands are typically flooded twice a day by tides, drying out in between. Some coastal wetlands remain open most of the year, while interior and northern wetlands freeze for the winter.

[1] Canadian Wildlife Service, 2002.

[2] *Definitions* can be found in the GLOSSARY.

Wetlands vary greatly by region of the province, and so too do the challenges of managing these important ecosystems. Common wetland types are listed below.

Freshwater Wetlands

Some wetland types are easier to recognize than others. For detailed information on the various wetlands types and characteristics, see *Wetlands of British Columbia: A Guide to Identification* (McKenzie and Moran, 2004).

There are many wetland types in B.C., distinguished by the depth and frequency of flooding and the nutrient qualities of the soils.

- **Bogs** are wetlands are dominated by *Sphagnum* peat mosses, which soak up large quantities of water, and create acidic conditions. They may include shrubs and stunted trees. Bogs and fens occur in more northern parts of B.C., generally away from agricultural or urban development.
- **Fens** are peatlands formed by a high water table. They are less acidic than bogs, and contain more mineral-rich groundwater. Fens are the most common type of wetland in British Columbia. They may include sedges, mosses, reeds, and shrubs.
- **Marsh wetlands** are shallowly flooded (permanently or periodically) by slow moving water, and are rich in nutrients. They are characterized by emergent vegetation (reeds, rushes, cattails and sedges). They are common along temperate lakes and in tidal coastal areas.
- **Swamps** form where standing or gently moving water occurs seasonally or persists for long periods, leaving the subsurface continuously waterlogged. They are most common in southern temperate areas of the province. They are distinguished by the presence of trees or tall shrub thickets.
- **Shallow open water wetlands** are usually permanently flooded, relatively small bodies of standing or flowing water, often representing a transitional stage between lakes and marshes. They include potholes, sloughs or ponds as well as waters along river, coast and lakeshore areas. They are dominated by rooted, submerged, and floating aquatic plants.
- **Saline meadows** are periodically saturated and occasionally inundated sites. After a brief period of inundation, the watertable drops below the rooting zone during most of the growing season, resulting in a well-aerated rooting medium. They are dominated by grasses, rushes, or *halophytes*.

FRESHWATER WETLANDS

Bogs—dominated by mosses.
PHOTO: ROBERT COX

Fens—sedges, reeds, and shrubs
PHOTO: JUDITH CULLINGTON

Marshes—emergent vegetation.
PHOTO: JUDITH CULLINGTON

Swamps—trees and tall shrubs.
PHOTO: DOUG BIFFARD

Shallow open water—rooted, submerged and floating aquatic plants. PHOTO: JUDITH CULLINGTON

Saline meadows—sedges, reeds, and shrubs.
PHOTO: JUDITH CULLINGTON

- **Shrub-carr ecosystems** develop on frost-prone sites with moist or very moist soils. These sites are seasonally saturated but rarely inundated (see flood ecosystems) and may have watertables perched at depth.
- **Low bench floodplain ecosystems** occur on sites that are flooded for moderate periods (< 40 days) of the growing season, limiting the canopy to tall shrubs, especially willows and alders. Annual erosion and deposition of sediment generally limit understorey and soil development.
- **Middle bench floodplain ecosystems** occur on sites briefly flooded (10–25 days) during freshet, allowing tree growth but limiting tree species to only flood-tolerant broadleaf species such as black cottonwood and red alder.
- **High bench ecosystems** occur where flooding rivers produce lengthy subsurface flow in the rooting zone but only periodic, brief inundation. Plant communities are similar to adjacent upland forests.
- **Ephemeral wetlands** are temporary wetlands, usually drying out in summer and fall. They are sensitive habitats that are often home to rare species. Many of the plants that are associated with these sites are adapted to the wet/dry cycle and are rare because this habitat type is not common. These pools are frequently undervalued because they retain water only part of the year.

Ephemeral wetlands (vernal pools) should not be turned into permanent wetlands as this will affect their suitability as habitat for many species, including species at risk.
PHOTO: MARLENE CASKEY

Saltwater Wetlands

"*Estuarine ecosystems are defined as: coastal sites dominated by plants and other organisms tolerant of wet, brackish soils, found at the confluence of a freshwater source and the marine environment and affected by occasional or diurnal tidal inundation.*" (McKenzie and Moran, 2004)

Estuaries are therefore one of the most productive types of ecosystems on earth; although they make up only 3% of the coastline in B.C., they are used by approximately 80% of all wildlife species on the coast. They are also critical to the survival of many marine organisms including salmon and trout.

- **Estuarine marshes** are intertidal ecosystems that are flooded diurnally. These marshes occur in the middle to upper tidal zones of estuaries where saltwater influences predominate, and are dominated by emergent herbs, grasses, or low shrubs.
- **Estuarine meadows** occur in the high intertidal and supratidal zones of estuaries, where tidal flooding occurs less frequently than daily and is tempered by freshwater mixing. Species composition is relatively diverse, typically with a mix of *graminoids*[3] and *forbs*[4].

[3] Grasses, sedges and rushes

[4] Herbaceous flowering plants

SALTWATER WETLANDS

Estuarine marshes—saltwater influence.
PHOTO: DOUG BIFFARD

Estuarine meadows—high intertidal.
PHOTO: DOUG BIFFARD

1.1.2. Status of Wetlands in B.C.

An estimated 500,000 hectares of wetland, bog and riparian habitats are protected in provincial parks and protected areas. Of the 152 ecological reserves formally established in B.C., 52 are dedicated to the protection of aquatic habitats.

(Wetland Stewardship Partnership, 2006. Wetland Action Plan for British Columbia)

Wetlands make up about 5.6% or 5.28 million hectares of British Columbia. Information on the status of wetlands in British Columbia is incomplete, however studies show that in southern regions of the province, 60–98% of original wetlands have been drained and filled. Wetland habitat losses have reached 85% in the ecologically sensitive South Okanagan, 50–70% in the Fraser Lowlands, and higher in parts of Vancouver Island. In the less populated central and northern regions of the province, significantly greater amounts of wetland remain. The degradation and fragmentation of wetlands, and loss of smaller wet meadows and vernal pools are usually not considered in loss calculations, but can add considerably to the statistics for the total loss of wetlands.[5]

Wetlands provide valuable habitat.
PHOTO: JUDITH CULLINGTON

[5] Wetland Stewardship Partnership, 2006.

Wetland features are physical attributes that create many different types of habitat for different species. Examples include snags (standing dead trees), vegetation cover, and large woody debris.

Wetland functions are processes that keep the ecosystem operating. Examples include water infiltration, evapotranspiration and nutrient cycling.

The Canadian Wildlife Service provides an overview of different approaches to conducting wetland ecological function assessments, recognizing that there is no single best method for all regions or situations. For more information see **Wetland Ecological Functions Assessment: An Overview of Approaches** (Hanson et al, 2008).

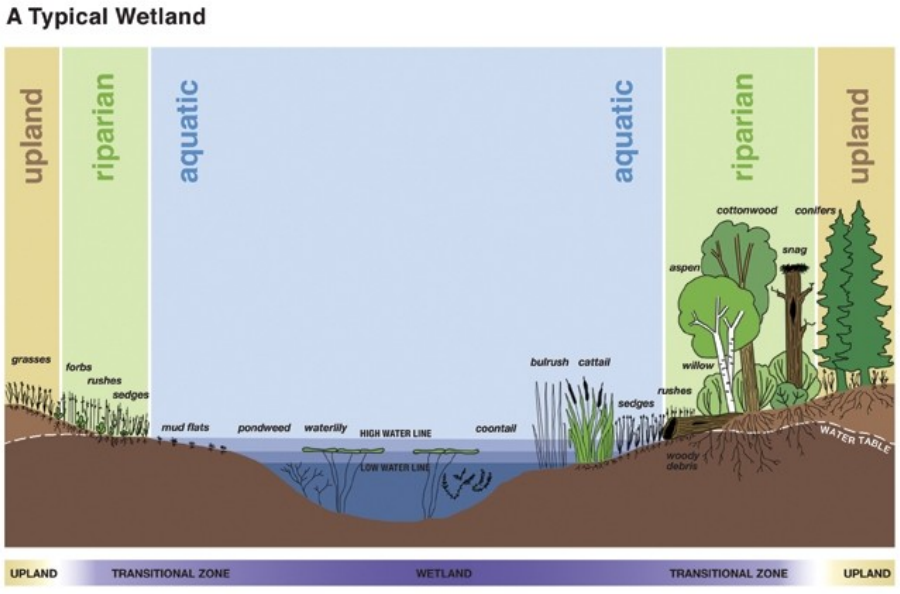
1.1.3. Wetland Ecology

Hydrology

Hydrology—the flow of water in and over the land, the depth of water, and the extent of the wetted area—is a defining characteristic of a wetland. Alterations to hydrology, caused by climate change, human activities or natural changes over time, will modify the size and type of wetland.

Water enters the wetland from precipitation, surface or groundwater flows, or tidal flooding. Water can leave the wetland through outflow streams, tidal flow, by infiltrating into soils and recharging groundwater, from evaporation of the water, and transpiration from plants. The balance between the inflow and outflow of water is called the **water budget**.

The pH value—acidity or alkalinity—of the water will influence the type of vegetation that will grow. For example, in sites with high acidity and poor nutrient supply, *Sphagnum* mosses will predominate. Where the site is more alkaline, brown mosses[6] will be dominant.



Wetland zones in a typical wetland.
SKETCH: DUCKS UNLIMITED CANADA

[6] e.g., *Campylium*, *Tomenthypnum*, *Calliergon*, *Drepanocladus* species.

Soils

Wetland soils are generally anaerobic, i.e., lacking in air. They can be mineral or organic, or a combination of both. The lack of oxygen slows the decomposition process of dead plant material so that organic material accumulates faster than it can decompose, resulting in a build-up of organic material at the surface. Over many years, this peat layer can become very thick.

Wetland soils showing layers. PHOTO: SARMA LIEPENS

Gleying occurs in waterlogged, anaerobic conditions when iron compounds are reduced and either removed from the soil, or segregated out as mottles or concretions in the soil. Marshy wetlands often contain gleyed soils. http://www.soil-net.com/advanced/soil_formation4.htm

See also the Canadian System of Soil Classification, http://sis.agr.gc.ca/cansis/taxa/cssc3/chpt7.html

Beneath the peat the wetland soils are subhydric (under water) or hydric (waterlogged). Long periods of waterlogging in mineral soils transform iron and manganese, creating *gleyed* soils with bluish-grey colour. Periodic flooding results in mottled soils, with reddish blotches caused by the rusting of the iron during dryer periods. Wetland soils are often characterized by hydrogen sulphide, producing a 'rotten egg' smell.

Vegetation

The water-saturated environment of wetlands supports a unique group of plants called *hydrophytes*: plants adapted to grow in waterlogged soils. These plants must find ways to cope with specialized conditions, including waterlogged soils and lack of oxygen in the soils.

HYDROPHYTES: PLANTS THAT LIKE HAVING 'WET FEET'

Wetlands support plants called **hydrophytes** that are adapted to grow in waterlogged soils. **Obligate hydrophytes** (plants that must have waterlogged soils, such as great bulrush) are restricted to wetlands and semi-aquatic sites. **Facultative hydrophytes** (that can tolerate wet soils but can also grow in dryer areas, such as Labrador tea) occur commonly in wetlands but also appear on some upland sites.

Bulrush – an obligate hydrophyte.
PHOTO: JUDITH CULLINGTON

Labrador tea – a facultative hydrophyte.
PHOTO: JUDITH CULLINGTON

A Dynamic System

Wetlands naturally change over time. In wetlands that contain water year round, plant biomass may accumulate at the surface, gradually raising the level of the wetland and making it progressively shallower until meadow and then forest plants can survive. In estuaries, rivers and streams will deposit sediments that build up and extend the shoreline.

Beaver dams can create or alter wetlands. PHOTO: SARMA LIEPENS

Animals can also have an impact on wetlands. Beavers, for example, will build dams, creating or altering wetlands and the way water moves over the surface.

Climate and Climate Change

The creation of wetlands is greatly influenced by regional climate because of the balance between water inputs (precipitation) and water loss from evaporation and drainage. Peaty bogs and fens form in B.C.'s cool northerly climates with low evaporation and slow drainage. The dry and warm regions of the province typically have only limited peatland development because warm temperatures increase decomposition rates while higher evapotranspiration rates limit the extent of sites that have permanent saturation.

CLIMATE CHANGE WILL AFFECT WETLANDS WORLDWIDE

"*Climate change will affect wetlands through:*

- *Sea level rise*
- *Increased sea temperatures*
- *Changes in hydrology*
- *Increased temperature of wetland water bodies*
- *Increased temperature in tundra and polar areas*

Land use change and water consumption patterns will accentuate climate change impacts on wetlands."

(IUCN, Bergkamp and Orlando, 1999)

Future changes to B.C.'s climate, notably increasing temperatures, changes in precipitation and sea-level rise, are the main aspects of climate change that will affect wetland distribution and function.[7]

Increasing temperatures will result in warmer water temperatures in wetlands and adjacent watercourses. This effect will be noticed most at northern high latitudes where biological productivity would increase. Rare and endangered plant and animal species with sensitivity to small temperature changes often have no alternative habitat, especially in isolated areas such as those in montane and alpine wetlands.

Temperature change will also affect water supply to wetlands, especially in areas where precipitation is currently predominantly from winter snowfall and stream-flow comes largely from spring and summer snowmelt. Lower snowpacks will reduce summer water supply.

Changes in precipitation will affect water inputs to wetlands. Arid and semi-arid areas are especially vulnerable to changes in precipitation as a decline in precipitation can dramatically affect wetland areas.

Sea-level rise will affect saltwater ecosystems, inundating saltwater marshes and changing the character of estuaries.

Wetlands can affect global climate change, as well as being affected by it. Wetlands play an important role in *carbon sequestration*, storing large quantities of carbon—almost twice as much carbon as surrounding agricultural lands.[8] Globally, wetlands cover approximately 6% of the land surface but contain 14% of the land-based carbon pool. However,

7. http://www.ramsar.org/key_unfccc_bkgd.htm#2

8 Euliss et al. (2006) reported in Ducks Unlimited, http://www.ducks.ca/conserve/research/projects/climate/carbon.html

WETLAND VALUES

Environmental economists have used various methods to estimate the economic market and non-market values of the goods and services of various ecosystems. For wetlands, the total value was estimated to be $19,580 hectare/year (1994 US$) (Costanza, 1997). Using this figure to estimate the goods and services value of wetlands, British Columbia's total wetland surface area of 5.28 million hectares would yield a potential value of over $100 billion/year. At a local level such as the Fraser Valley, the total wetland surface area of 41,906 hectares would yield a potential goods and services value to society of over $800 million/year.

wetlands also release greenhouse gases such as carbon dioxide, methane, and nitrous oxide.

The capability of wetlands to store carbon is largely a result of their productivity. Wetlands are among the most productive ecosystems in the world. Additionally, wetlands are often anaerobic (without oxygen) which greatly reduces the rate of decomposition relative to aerobic systems. Due to these facts production usually exceeds decomposition in wetlands and results in the net accumulation of organic matter and carbon. Changes in wetlands will bring changes to the carbon balance.

A hectare of wetland has an estimated economic value of $5,792 to $24,330 a year – this considers all the benefits provided, including water purification, flood control, refuge for animals, and more. (Olewiler, 2004)

If the approximately 40,000 hectares of the Lower Fraser Valley wetlands were valued for services provided, at the lowest estimate it would still be worth over $231 million per year! (Living Water Smart)

Canada's wetlands provide flood control worth $2.7 billion annually. (National Wetlands Working Group, 1988)

The recreational value of intact wetlands in Alberta and Saskatchewan was $1,490/ha, compared with only $37/ha for wetlands drained and used for cultivation.

1.1.4. Wetland Functions and Values

Wetland *functions* are the natural processes (chemical, physical and biological) that occur in wetlands and can render services that are of value to humans and society in general. Wetland *values* reflect the ecosystem services that wetlands provide to humans and the societal values placed upon these services. Wetland values are based on wetland ecological functions but the two are not synonymous.[9] Table 1 outlines some of the more common wetland functions and the values that have been associated with these functions.

Wetlands are among the most productive ecosystems on earth. PHOTO: CLAIRE DE LA SALLE

[9] See Hanson et al, 2008.

Table 1: Examples of Wetland Buffer Functions and Values

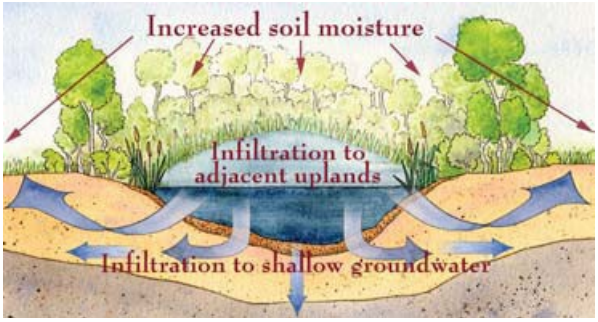
Function	Value
Wetland plants absorb and retain nutrients, pathogens and pesticides and prevent much of this from entering streams and groundwater.	♦ Provides clean drinking water to downstream users and improves the aquatic habitat
Wetlands store large amounts of rainwater and gradually release it to streams and groundwater.	♦ Reduces the risk and severity of flooding ♦ Helps maintain flows during low flow periods for downstream habitat and water users
Wetland habitats are among the most productive ecosystems on earth.	♦ Sustain high levels of biodiversity and provide habitats for species at risk. ♦ Provide opportunities for harvestable species (e.g., trees and other agricultural products)
Riparian and aquatic vegetation stabilizes shorelines and minimizes erosion.	♦ Reduces risk to downstream property owners and protects downstream water quality and habitat
Carbon fixation and CO^2 balance Methane equilibrium Rainfall and humidity increases Micro-climatic influences	♦ Maintaining current climate for human activities and society

WETLANDS SUPPORT AGRICULTURE

Wetlands:

- Are a water source for livestock;
- Provide productive grazing and hay;
- Provide a source of water for irrigation of crops;
- Help to maintain a high water table, resulting in fuller dugouts, better soil moisture, and increased production in adjacent crops;
- Increase the amount of soil moisture available for crop and forage production—undrained watersheds have significantly more moisture in the top 1.5 m of the surrounding soil compared to drained watersheds.

Alberta Environment: Cows and Fish



Wetlands increase soil moisture for croplands. IMAGE FROM COWS AND FISH. HTTP://WWW.COWSANDFISH.ORG/VALUEOFWETLANDS.PDF

1.1.5. Impacts of Human Activities on Wetlands

In the past, 'swamps' were popular sites for dumping garbage. Many were filled in for 'more productive' uses: Victoria's Empress Hotel, for example, stands on the site of a former wetland.

Human activities can directly or indirectly change wetlands in many ways.

Changes to wetlands can harm habitats for species such as this Pacific Tree Frog.
PHOTO: SARMA LIEPENS

- **Filling and/or draining**: Wetlands were often filled and drained for raising crops, constructing roads and buildings.
- **Changes to the water balance**: many changes happen inadvertently. For example, a new road may be carefully sited to avoid a wetland, but if that road cuts off the water inflow to the wetland, it will dry up. Too much water is also of concern, if a seasonally flooded wetland is turned into a year-round water feature, the ecology will change significantly. Independent Power Projects may alter the inflow of water to wetlands.
- **Water extraction**: use of groundwater or surface water can lower the water table or stream inflows, reducing water to wetlands.
- **Sedimentation**: nearby development such as road-building can lead to increased amounts of sediment in the water.
- **Peat mining**: mining of wetlands for peat will significantly change the wetland ecology.
- **Invasive species**: Species such as purple loosestrife can invade wetland areas, replacing native vegetation. This in turn can lead to losses of the animals that relied on the wetland habitat.

1.1.6. The Wetland Management Guidelines

Wetland Ways provides a series of recommended practices to protect and maintain existing wetlands and move towards an increase in wetland area. The guidelines and suggestions in **CHAPTER 2** apply to all wetland managers and users. Other chapters provide information for specific groups, professionals or activities.

All chapters are available on-line at the Ministry of Environment website http://www.env.gov.bc.ca/wld/BMP/bmpintro.html and the Ducks Unlimited website http://www.ducks.ca/province/bc/index.html.

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